FLUORESCENT COLOR SCANNING METHOD FOR USE IN A SCANNER

BACKGROUND OF THE INVENTION

1. Field of the invention

5   The present invention relates to the scanning operation of an optical scanner and, more specifically to a fluorescent color scanning method used in a scanner to accurately scan documents containing fluorescent substances.

2. Description of the Related Art

Following fast development of computer technology, the trend of office

10   automation keeps going forward. To achieve office automation, it is necessary to scan paper documents into electronic files for transmission by E-mail through a network.

Because of the attractively bright-colored feature, fluorescent substance is intensively used in a variety of documents, for example, used in ink for color

15   printer, paper, and fluorescent markers. However, because the radiance factor of regular commercialized fluorescence is over 1 under visible spectrum, it is difficult to accurately obtain the original fluorescent color by means of conventional scanning methods. FIG. 1 is a radiance factor-wavelength curve obtained from a salmon fluorescent substance under a standard light source A

20   subject to CIE (Commission International de l'Eclairage). As illustrated, the radiance factor of the fluorescent substance is about 1.25 at wavelength 610nm, which is much higher than the radiance factor of the reference substance of standard white used in scanners (i.e., whiteboard). Therefore, when scanning

this salmon fluorescent substance with a scanner, a saturated phenomenon occurred at the photon received by the red color sensor, or at the converted signal, thereby causing a signal ratio distortion at the red color, green color and blue color sensors that control color tone and hue. Therefore, there are differences between the color tone and hue of the image scanned and the original document.

SUMMARY OF THE INVENTION

The present invention has been accomplished under the circumstances in view. It is therefore the main object of the present invention to provide a fluorescent color scanning method, which eliminates color distortion. It is another object of the present invention to provide a fluorescent color scanning method, which accurately judges the presence of a fluorescent color in the document. It is still another object of the present invention to provide a color conversion method, which enables the scanner to produce accurate color output.

To achieve these and other objects of the present invention, the fluorescent color scanning method comprises the steps of: (a) using a light source of a predetermined brightness to scan a standard white so as to obtain a first reference white W1(R,G,B) in which R indicates red color; G indicates green color; B indicates blue color; (b) reducing the brightness of said light source, and then scanning said standard white to obtain a second reference white W2(R,G,B); (c) using said first reference white W1(R,G,B) as the standard to scan every scanning point and then storing the scanned result of

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each scanning point by means of Pm(R,G,B), in which m=1, 2, 3..., m that represents the respective scanning point; (d) using said second reference white W2(R,G,B) as the standard to scan every scanning point of the document to be scanned and then storing the scanned result of each scanning point by means of

5   Qm(R,G,B); and (e) comparing the value of W2(R,G,B) to the value of Qm(R,G,B), so as to determine if the document contains a fluorescent color or not subject to: (i) determining that the document contains a fluorescent color if Qm(R) > W2(R), Qm(G) > W2(G), or Qm(B) > W2(B), and then converting said Qm(R,G,B) into the accurate color output Om(R,G,B) based on said

10   W1(R,G,B) through a conversion method, and (ii) determining that the document contains no fluorescent color if $Qm(R) \leq W2(R)$, $Qm(G) \leq W2(G)$, and $Qm(B) \leq W2(B)$, and then using the value of Pm(R,G,B) as the image output value.

BRIEF DESCRIPTION OF THE DRAWINGS

15   The accompanying drawing is included to provide a further understanding of the invention, and is incorporated in and constitutes a part of this specification. The drawing illustrates an embodiment of the invention and, together with the description, serves to explain the principles of the invention. In the drawing,

20   FIG. 1 is a radiance factor-wavelength curve obtained from a salmon fluorescent substance under a standard light source A subject to CIE.

FIG. 2 is a flow chart of the present invention.

FIG. 3 illustrates the architecture of a scanner constructed according to

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the present invention.

FIG. 4 is a schematic drawing of a scanner showing a neutral density filter set in front of the lens according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

5   In order to have the scanner show accurate chroma and hue when scanning a fluorescent color, the invention detects the presence of a fluorescent color in document by means of reducing the scanning brightness. In case document contains a fluorescent color, the scanning result is converted through a proper conversion before output, so that the output image has the accurate

10   color.

Referring to FIG. 2, the fluorescent color scanning method in accordance with the present invention is shown comprising the steps of:

S20 starting the scanner;

S22 scanning a whiteboard of standard white to obtain a first reference white

15       $W1(R,G,B)$, i.e., scanning the brightest point of scanning reference, for

example $W1(R,G,B)$ set to be (255,255,255) for pixel of 8 bits;

S24 reducing the brightness of the light source or the brightness of the light

entered the scanner, and then scanning the whiteboard of standard white to

obtain a second reference white $W2(R,G,B)$, which has a value smaller

20   than the value of $W1(R,G,B)$;

S26 scanning the picture of the document based on the standard of $W1(R,G,B)$,

and then storing the scanned result in $Pm(R,G,B)$;

S28 scanning the picture of the document based on the standard of $W2(R,G,B)$,

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and then storing the scanned result in $Qm(R,G,B)$;

S30 comparing the value of $Qm(R,G,B)$ to the value of $W2(R,G,B)$, so as to determine if the document contains a fluorescent color or not, and then proceeding to step S32 if positive, or step S36 if negative;

5   S32 converting the scanning result $Qm(R,G,B)$ into the accurate color output $Om(R,G,B)$ based on $W1(R,G,B)$ when $Qm(R) > W2(R)$, $Qm(G) > W2(G)$, or $Qm(B) > W2(B)$;

S34 obtaining the accurate color tone and hue output value $Om(R,G,B)$ in which; $Om(R)=Um(R)*W1(R)$; $Om(G) =Um(G)*W1(G)$; $Om(B)$

10     $=Um(B)*W1(B)$;

S36 $Pm(R,G,B)$ being the accurate color scanning result.

In the aforesaid step S30, determining the presence of a fluorescent color in document is determined subject to the result of comparing $Qm(R,G,B)$ to $W2(R,G,B)$, i.e., document is confirmed containing a fluorescent color if

15     $Qm(R)>W2(R)$, $Qm(G)>W2(G)$, or $Qm(B)>W2(B)$. In this case, one color sensor is saturated. Therefore, the scanning result must be properly converted to provide the accurate chroma and hue before output. However, if $Qm(R) \leq W2(R)$, $Qm(G) \leq W2(G)$, and $Qm(B) \leq W2(B)$, it means no fluorescent color in document. In this case, proceed to step S36, i.e.,

20     $Pm(R,B,G)$ is the accurate scanning result.

In the aforesaid step S32, the conversion is achieved by: setting the maximum value of $Qm(R)$, $Qm(G)$, and $Qm(B)$ to be Bm and then calculation the ratio of each color $Um(R,G,B)$ in which $Um(R)=Qm(R)/Bm$;

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$Um(G)=Qm(G)/Bm$; $Um(B)=Qm(G)/Bm$.. Based on $W1(R,G,B)$, obtain the accurate color tone and hue output value $Om(R,G,B)$ in which; $Om(R)=Um(R)*W1(R)$; $Om(G)=Um(G)*W1(G)$; $Om(B)=Um(B)*W1(B)$.

In the aforesaid method, fluorescent color scanning is achieved by means of the application of different brightness (light intensity). There are various methods to reduce scanning brightness. Hereinafter describes one example. FIG. 3 illustrates the architecture of a scanner, which comprises two lamps (light sources) 10. The document 12 is placed on the glass window 14 and then covered by the top cover 16 of the scanner. When scanning the document 12, light from the light sources 10 is reflected by the document 12 into reflected light, which passes through a reflector 18 into the lens 20 of the scanner. Thus, the image sensor module 22 of the scanner picks up light signal from the lens 20. Therefore, the two lamps 10 can be simultaneously turned on and then the scanning procedure is started to obtain a first reference white W1 and Pm, and then one lamp 10 is turned off and then the scanning procedure is started again to obtain a second reference white W2 and Qm. Alternatively, as shown in FIG. 4, a neutral density filter 24 may be set in front of the lens 20 to reduce the scanning brightness. In another way, a control circuit may be used to control the exposure time of each color sensor of the image sensor module so as to regulate the scanning brightness.

As indicated above, the method of the present invention enables the scanner to accurate scan fluorescent colors. By means of the present invention, it needs only to slightly change the architecture or control circuit of the original scanner. This minor architecture or control circuit change does not increase much cost while improving the scanning quality and increasing the added value of the scanner. Therefore, the invention has an industrial value.

A prototype of fluorescent color scanning method has been constructed with the features of FIGS. 2~4. The fluorescent color scanning method functions smoothly to provide all of the features discussed earlier.

Although particular embodiments of the invention have been described in detail for purposes of illustration, various modifications and enhancements may be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited except as by the appended claims.